

## Tularemia, Lawn Mowers, and Rabbits' Nests

The recent report by Goethert, Shani, and Telford has demonstrated that strains of *Francisella tularensis* subsp. *tularensis* (type A) on the island of Martha's Vineyard are of multiple genotypes (3). In that paper, the authors stated that the mode of transmission of the two outbreaks (summer 1978 and summer 2000) of pneumonic tularemia (1, 5) from this island remain "undescribed" (3).

I propose the application of Occam's razor to explain these pneumonic tularemia outbreaks. To do so requires consideration of two categories of facts. First, epidemiologic investigations have revealed that among the risk factors for the development of pneumonic tularemia was the use of lawn mowers and brush cutters (2). Second, the nesting habits of the major reservoir host, the cottontail rabbit (*Sylvilagus floridanus*) need to be considered. The cottontail rabbit, after beginning breeding in early spring, creates pocket nests, shallow depressions 10 to 21 cm deep and 10 to 13 cm wide. The nest is lined with grass and fur; the upper opening can be hidden due to this grass lining and overgrowth of vegetation. Nesting locations can be pastures, pine plantations, and even mowed lawns. The female returns to the nest only to nurse her young, which, averaging five per nest, remain in it for 3 to 4 weeks. The average use of the nest is 26 days per brood, with a mean of three (and up to five) broods per summer (4). Rabbit nests therefore are populated with large numbers of growing bunnies most of the summer. In Wisconsin, this writer has had the experience of accidentally mowing over well-hidden broods with unintendedly sad results, and, undoubtedly, has passed over more while mowing lawns. If any such hidden nests have harbored sick cottontail rabbits, aerosolization of *F. tularensis* could be expected.

Therefore, the introduction of infected rabbits by humans to Martha's Vineyard in 1937 (5), along with the use of modern power lawn mowers, is probably another example of human environmental modification that has caused the emergence of a new route of transmission of tularemia.

Supporting data for this hypothesis could be found by a searching out of such rabbits' nests, as *F. tularensis* has been found to be viable in straw (and therefore probably rabbit-nest lining) for up to 6 months (1). Experimentally, mowing over infected nests could be shown to aerosolize this organism; however, extreme caution in such experimentation would be advisable.

As an aside, the seropositivity for *F. tularensis* of raccoons and skunks on Martha's Vineyard probably reflects their known scavenging of dead or dying animals. These predators could acquire infection from such sick or dying rabbits, analogous to the circumstances of prairie dog areas of the American Southwest, where coyotes have been found to be seropositive for *Yersinia pestis*.

Finally, this writer agrees with the authors that *Dermacentor* sp. ticks are uncommon vectors in propagating tularemia. A more likely tick, the rabbit tick (which also quests for ground-feeding birds), *Haemaphysalis leporispalustris*, could be studied as a possible route of dissemination of *F. tularensis* among rabbits on the island; however, this tick seldom bites humans.

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### Authors' Reply

We agree with Dr. Agger that the mode of tularemia transmission on Martha's Vineyard could very well be straightforward. Rabbit contact is said to account for the majority of all reported cases (3) in North America. Some of the Martha's Vineyard cases might be explained by someone unknowingly mowing over unoccupied rabbit nests, thereby aerosolizing rabbit excreta or ectoparasites (1). We are convinced, however, that cottontail rabbits and their associated ectoparasites are not necessarily required for perpetuation of *F. tularensis* subsp. *tularensis* or for zoonotic risk.

We have studied rabbits on nearby Nantucket Island for many years (2, 5) but have never found *F. tularensis* infection in these hosts (by necropsy or PCR analysis of blood) or in *Haemaphysalis leporispalustris*. Because Nantucket Island lacks carnivorous predators, with only raptors and cars serving to regulate their population, its rabbit densities are much greater than those of Martha's Vineyard. If rabbits and *H. leporispalustris* were sufficient for maintaining *F. tularensis*, we would expect to find evidence of transmission on Nantucket. Landscaping activities are intense on both islands, but we have seen only 2 human cases in the last 5 years on Nantucket Island, as opposed to 30 cases on Martha's Vineyard. Perhaps the occasional Nantucket Island human cases are due to introduction of ticks by birds, but this begs the question as to why the agent does not spread rapidly among Nantucket rabbits afterwards.

The main ecologic difference between the two islands is that Nantucket Island lacks skunks and raccoons. Furthermore, Nantucket Island lacks dog ticks. Without the presence of their primary reproductive hosts (skunks and raccoons) and with the recent use of acaricides such as Frontline on dogs, the few small foci of dog ticks that were on Nantucket Island have virtually disappeared. We demonstrated that dog ticks are frequently infected by *F. tularensis* on Martha's Vineyard, but their role in perpetuation remains to be fully described. Human cases rarely occur on Nantucket Island, which has no dog ticks but does have many rabbits with rabbit ticks. Surely this provides us with a hint that the tularemia enzootic cycle is

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much more complicated than longstanding dogma about rabbits and risk would suggest.

Although lawn mower-associated tularemia certainly occurs, it is not clear that this is the main mode of transmission to landscapers on Martha's Vineyard or whether the cases there comprise primary pneumonic tularemia (K. Stralin, H. Eliasson, and E. Back, Letter, *N. Engl. J. Med.* **346**:1207–1208, 2002). It may be that *F. tularensis* on Martha's Vineyard includes variants that rapidly disseminate to the lungs following exposure, or ones that fail to always produce typical ulceration and draining lymphadenopathy when delivered by arthropod bite. One Nantucket Island case presented as community-acquired pneumonia and no lymphadenopathy but was found to have a small eschar on his ear suggestive of a fly bite (4). Whether the infected Martha's Vineyard landscapers also sustained overlooked skin lesions remains undescribed.

Interestingly, mowing over infected rabbits may not always be the extreme hazard it would seem. In 2003, a Nantucket Island landscaper ran over a rabbit with a lawnmower. It was

not he who developed tularemia but his coworker, who moved the carcass to the bushes with a stick.

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